**Lassen Peak, California: Preliminary mineral mapping results using high and low altitude AVIRIS data**

James K. Crowley and John C. Mars, U. S. Geological Survey, Reston, VA 20192

Abstract

Hydrothermally altered rocks on stratovolcanoes are an important cause of structural weakening that can lead to edifice collapse and potentially catastrophic volcanic debris flows. High altitude AVIRIS data have proven useful for mapping altered edifice rocks, although subtle spatial and compositional details are not always resolvable. Low altitude AVIRIS data may enable better characterization of the structural and mineralogical features on volcanoes that contribute to large slope failures. Lassen Peak, a stratovolcano overflown by AVIRIS in 1996, was selected to compare the use of high and low altitude AVIRIS data for volcanic alteration studies. Results reported here are preliminary as field work will not be practical until Summer, 1999.

Lassen Peak last erupted in 1914-1917 and is the second most recently-active Cascade stratovolcano. The Lassen Peak area has been a locus of volcanic activity for several hundred-thousand years, and includes the eroded remnants of an ancient volcano near Brokeoff Mountain, situated about 5 kilometers southwest of Lassen Peak itself. Hydrothermally altered rocks are found throughout the area, and include two distinct varieties: (1) rocks associated with recent, acid, hot-spring activity, with mineral assemblages characteristic of acid-sulfate alteration, and (2) rocks that represent the exposed propylitically altered core of the former Brokeoff volcano.

The 1996 high altitude AVIRIS data were calibrated to reflectance by using ATREM, followed by rescaling based on a ground target composed of unaltered dacite. The low altitude data were then calibrated to reflectance using scalars derived from a spectrally-flat area in the calibrated high altitude data. A combination of spectral unmixing, matched filtering, and spectral shape analysis was used for mineral mapping.

Despite the large spatial resolution differences (1.4 m versus 16 m), the high and low altitude AVIRIS data sets gave very consistent mapping results. Both data sets were effective for mapping solfataric assemblages of alunite and kaolinite, as well as propylitic alteration mainly consisting of smectite clay. The low altitude data provided much better resolution of mineral patterns associated with narrow, fault-like, structural features--defined by occurrences of ordered kaolinite in structures, versus poorly-ordered kaolin forms elsewhere. Such structural features may represent potential failure surfaces for landslides, and determinations of feature spacing, length, and mineral characteristics are important for assessing edifice stability. The large volumes of data obtained when operating AVIRIS in low-altitude mode will necessitate careful spatial targeting, e.g., by using high altitude AVIRIS or other synoptic data to initially locate zones of altered rock.